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Which Cows Are More Efficient?

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On the surface, the topic of cow efficiency may seem to be primarily of importance to commercial cow-calf producers. The topic is also of importance to seedstock producers, because the primary purpose of the seedstock industry is to provide genetic resources for the commercial industry. It is critical that seedstock producers develop a good understanding of the challenges faced by commercial producers in order to provide the best possible services.

Feed costs for the cow herd represent the single largest expense in producing retail beef. The proportion of total energy utilized in beef production that is required to support the breeding herd is larger for cattle than for most other meat species, because of a relatively low reproductive rate. Fortunately, much of the energy for the breeding herd can be supplied through feedstuffs that are readily grown in areas not well suited for tillable crop production, and can be harvested economically by the cow herself. While relatively cheap, such feedstuffs are not free. Furthermore, supplemental feeding is needed at times to sustain the cow herd year-round. An important objective for the commercial producer, then, would seem to be to limit feed costs. However, attempts to decrease feed costs should be approached with caution because of the effects of cow nutrition and body condition on reproductive success.

Matching Genetic Type to Environment

The concept of matching genetic type to the existing environment has received a lot of attention in recent years. It is often more economical to utilize resources that are inherently available rather than those that must be purchased elsewhere. Thus, it seems it logical for most commercial producers to choose cattle types that fit the local resources rather than choose cattle types they happen to like and then adjust resources to fit the cattle. Of course market demands should also dictate cattle type. Environmental criteria include feed availability and factors related to stress such as temperature, moisture, wind, terrain, disease and parasites. Genetic factors include milk yield potential, mature size, and stress resistance (adaptability). The concept sounds great, but the challenge under most situations is that the environment at a given location is not constant. Year to year differences and particularly seasonal differences can be quite extreme.

The Flexible Cow? In the northern plains region, we have both heat and cold stress. We have good feed supplies some years and are plagued by drought in other years. Such variable conditions dictate that we use cow types that are tolerant to a wide range of environmental conditions, rather than cow types with specialized adaptations. We generally learn through trial and error which breeds are generally well suited to a particular environmental situation. Imposed and natural selection within a breed can further enhance adaptability, but requires considerable time. In seedstock production, we might consider more emphasis on selection under commercial conditions as opposed to conditions that provide for maximum expression of the animal's genotype for growth.

Antagonisms Between Traits

An intricate network of interrelationships among cow size, cow feed requirements, milk production, reproductive efficiency, calf growth rate and feed conversion are important to the net efficiency of production. Selection on one trait will cause correlated changes in other traits. Some relationships of concern include cow milk production potential and mature size with feed requirements; carcass leanness with marbling and cow fleshing ability; and, growth rate with mature size, carcass weight, and calving ease.

The existence of antagonisms between traits indicates a need to select for a balance of traits rather than extremes. On the other hand, all pure breeds do not have to be all things to all producers, because crossbreeding systems allow the commercial producer to combine the strengths of different breeds in a complementary manner. Terminal breeding systems that distinguish between

sire types and dam types have the potential to reduce the effects of antagonisms between traits. Each breed organization and each individual seedstock breeder must determine the extent to which they should emphasize general-purpose versus specialized breeding stock. In general, we expect general-purpose stock to be used in rotational breeding systems and specialized stock to be used in terminal matings.

Milk Production

Higher milk-producing cows require more feed, and produce larger calves. Remembering the law of diminishing returns, the key is to avoid going beyond the point where the extra weaning weight is no longer sufficient to pay for the extra feed costs.

Evidence suggests that higher milking breeds require more feed per unit of cow weight not only during lactation, but also to maintain energy or weight equilibrium (i.e., maintenance requirements) in dry, nonpregnant cows (Ferrell and Jenkins, 1984; Solis et al., 1988). The relationship of milk production with overall efficiency of feed utilization by a cow and her calf is less clear. Montano-Bermudez and Nielsen (1990) evaluated low, medium and high milk potential breed groups, and reported a slight advantage in efficiency of feed utilization to weaning for the low group. They also reported diminished postweaning feed efficiency for calves from the high milk group. Figure 1 shows relationships of milk yield and cow size with efficiency of feed utilization for weaned calf production from an SDSU study of first-lactation beef females and their calves (Freking and Marshall, 1990). Production efficiency was calculated as cow-calf feed energy (ME) per unit of calf weaning weight, and so a lower value indicates improved efficiency. The figures for milk production are based on calf intake after an overnight separation from the dam. At any given cow size, increased levels of milk yield were associated with improved efficiency of feed utilization to weaning. The incremental improvement in efficiency, though, was less with each additional unit increase in milk yield.

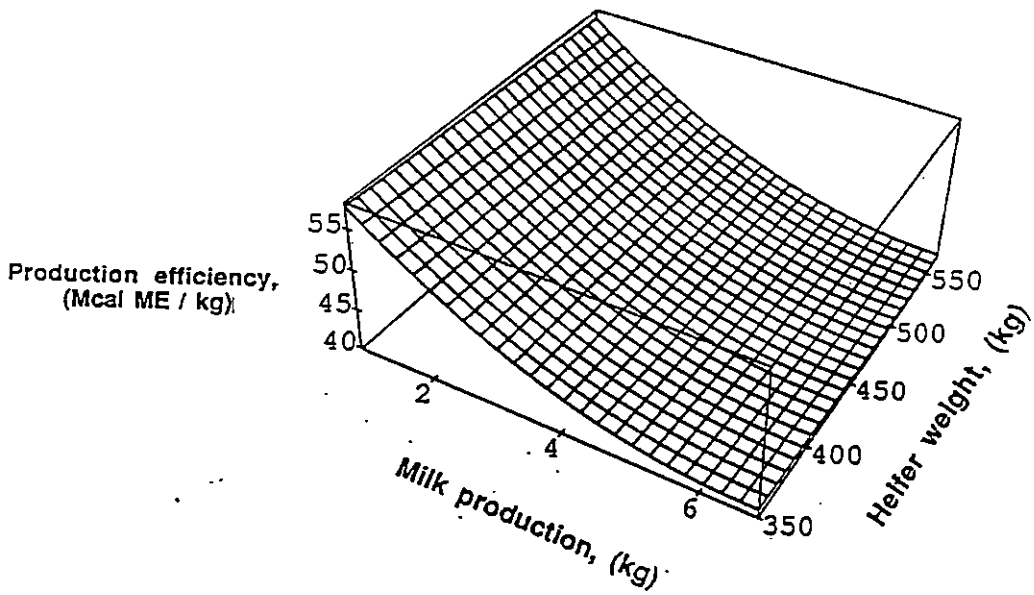

Figure 1. Relationships of overnight milk production and heifer size to production efficiency (cow and calf ME / calf weaning weight) in first-calf heifers. Adapted from Freking and Marshall (1990).

It has often been suggested that cow milk yield potential should be matched to the feed supply, letting cow reproductive performance serve as a guideline to tell us when we're getting too extreme. An additional factor that deserves attention, but has generally been overlooked, is the

volume of milk that the calf can efficiently utilize. Results of Taylor et al. (1986) suggest that cows convert feed to milk most efficiently when producing near their maximum potential. For example, if you want 18 lb of milk per day, then it more efficient to use to use cows whose maximum potential is approximately 18 lb than cows whose maximum potential is 30 lb. While it has always been recognized that sufficiently increased calf weaning weights must be produced by higher producing cows to maintain efficiency, we've tended to focus on this from an output (calf weight)-standpoint rather than from an input (calf intake) standpoint. Calf appetite and determining the optimal level of milk intake for a calf of a given growth potential appear to be areas where additional research could be useful. From the standpoint of a commercial breeding program, appropriately matching sire type to dam type would be the obvious approach through which we attain the optimal match of dam milk yield potential and calf milk intake.

Cow Size

Feed requirements per cow obviously increase with increasing cow size, although maintenance requirements per unit of cow weight do not appear to be affected by cow size (Ferrel and Jenkins, 1984). Furthermore, most studies have not shown a significant association of cow size with efficiency of feed utilization by the cow-calf pair to weaning (Marshall et al., 1976; Freking and Marshall, 1990). Simulation studies generally indicate that larger, higher producing cows are economically more efficient under conditions of an abundant, high quality feed supply, whereas smaller cows are more profitable when the feed supply is limited. A study conducted under Montana range conditions included Simmental-Hereford cross cows that were either 1/4, 1/2 or 3/4 Simmental (Table 1, Kress et al., 1990). The F1 group was intermediate in cow weight and calf weight, but ranked highest for calf weaning weight per cow exposed to breeding (i.e., when cow reproduction and calf survival were into account).

Table 1. Performance of Simmental-Hereford Cows in Montana[a]

Dam Breed Group	Cow weight, kg	Calf weight, kg	Calf wean wt per cow exposed, kg
1S3H	530	156	179
1S1H	545	161	189
3S1H	571	166	169

[a]Adapted from Kress et al. (1990)

Associations between feed supply, cow body condition, and reproductive performance have been established. Nature tends to respond to feed shortages by helping to ensure survivability of an existing calf by delaying or denying the conception of a future calf. The question of how cow size fits into this scheme is probably related more to management than to inherent genetics. Heritability tends to be quite low for most reproductive traits. In general, larger, higher producing cows will reproduce adequately if provided sufficient levels of appropriate quality feed. We have used both Angus-Hereford and Simmental-Hereford cross cows at the Antelope Range Livestock Station in northwestern South Dakota for a number of years, and have generally attained adequate pregnancy rates among both breed groups (Marshall et al., 1990). Pregnancy rates have averaged slightly higher numerically for the Angus-Hereford group, but the difference has not been statistically significant.

An Australian study was initiated in 1974 to compare the performance of three lines of Angus cattle, selected for either High growth, Low growth or at random (Control). Results based on the 1989 calf crop or on cow traits averaged over 1987-89 are presented in Table 2. The High line calves were heavier at all ages and High line cows were heavier and taller. In a cow-calf efficiency evaluation, the High line cows consumed more feed from calving to weaning, but increased weaning weights of their calves resulted in better efficiency of feed utilization. Preliminary data indicated no significant difference in reproductive performance of High versus Control lines. Calving

difficulty in heifers tended to be lower for High and Low lines compared to Control, while line differences in cows were not significant.

Table 2. Deviations From Control for Lines Selected for High Versus Low Growth Rate.

	Low	High
Birth weight	-15 %	+ 9 %
Yearling weight	-14 %	+15 %
Cow height	- 4 %	+ 3 %
Cow weight	-10 %	+ 8 %
Cow-calf feed eaten, calving to weaning	-1.6 %	+2.3 %
Adj. weaning weight	-9.6 %	+6.8 %
Cow-calf efficiency, calf wt / feed eaten	-8.0 %	+5.4 %

[a]Adapted from Parnell et al. (1990).

Calf Weight to Cow Weight Ratio -- A Note of Caution. The ratio of calf weight to cow weight is often used as an indicator of efficiency. Caution should be exercised with this ratio, however, as research has demonstrated it is sometimes biased, generally in favor of smaller breed types (Dinkel and Brown, 1978). This is basically because smaller cows, on average, must consume more feed per unit of body weight than larger cows to achieve a given level of production.

Management -- a Key to Cow Size. Close monitoring of body condition scores and pasture condition, in conjunction with adjustment of stocking rates and supplemental feeding, provide for some leeway in optimal cow size in a given environment. The ability of the producer to manage stocking rates, along with the relative cost of supplemental feeding, are among the factors that should be used to determine optimal cow size. The end result is that some producers can successfully utilize larger cows, while their close neighbors are better off with smaller, lower-producing cows.

Breed Effects

Few people care to see figures where their favorite breed ranks worse than other breeds for various characteristics. However, most seedstock breeders are willing to recognize that all breeds have strengths and weaknesses, and that breeds should be characterized by their potential contributions to breeding systems in commercial herds. Breed associations and individual seedstock breeders must identify those areas of the commercial industry for which they wish to provide services, and then develop breeding objectives accordingly.

A number of studies have looked at breed differences on efficiency of feed utilization by the cow-calf pair, with conflicting results. A couple of the earlier studies indicated relatively small differences between breeds for dam-calf conversion of feed energy to weaning weight (Klosterman et al., 1974; Marshall et al., 1976). Studies in which significant differences between breeds have been noted include those by Jenkins and Ferrel (1991) and Green et al. (1991). We should have additional results from work here at SDSU in the near future. One finding that many cow efficiency studies have had in common is a relatively large amount of variation from cow to cow in efficiency of feed utilization. When the full spectrum of economically important traits is considered, though, the common adage that there is more variation within than between breeds is not really true. Thus, selection of breeds is an important consideration for commercial production.

Several different breeds can be used with success with respect to environmental adaptability in this region, especially in an appropriately designed crossbreeding system. The British beef breeds have been selected within our environment for a long enough period of time to be well adapted.

The popularity of these traditional breeds in commercial crossbreeding is well-justified on that basis. The continental European breeds have not been selected under local conditions for nearly as long, but several of these breeds are well enough adapted to perform adequately, particularly in a crossbreeding program. Crossbreeding allows the use of some breeds that are not well-suited to the environment as straightbreds, because crossbreeding dilutes the proportion that a particular breed contributes to a given breeding system.

Most everyone would agree that no one breeding program is best for all commercial production situations. Even for a particular situation, more than one breeding system can generally be used with desirable results, although some may certainly work better than others. My feeling is that we can exercise quite a bit of flexibility in choosing breed types for a particular production system, as long as we avoid obvious mismatches among sire type, dam type, environmental resources, and management abilities. Personal preferences can and should play a role in breed selection.

Labor/Management Constraints

An important aspect of matching cattle type to resources that is sometimes overlooked is management ability. As mentioned previously, proper management of stocking rates and supplemental feeding is especially critical for high producing cows in order to attain adequate reproductive performance. Lower producing cows in general require less intensive management. Calving difficulty is another area of concern. Research papers often tout the potential efficiency of breeding systems that utilize a sire breed of larger mature size compared to the breed type of the dams. The logic of such a system is that maintenance requirements of the small-to-moderate size dam are held to moderate levels, while use of a "terminal" sire type will provide adequate growth potential in the calf. The problem with such a system is that the potential for calving difficulty tends to increase as the mature size difference between sire and dam increases. A producer who does not have the time and skills to effectively deal with calving difficulty should generally avoid using breeds or sires that are more prone to cause calving difficulty.

Consumer-Market Demand

The common recommendation for commercial breeding systems is to match cow type to resources and sire type to market demand. Again, the potential for calving difficulty must be considered. Several other questions should also be addressed. Are all calves sold at weaning or is ownership retained past weaning on some? What end market are cattle being targeted for -- the restaurant trade, supermarket trade, institutional trade or some other market niche? How important are leanness, marbling and size of the carcass for these markets? What other market-related criteria are important?

Summary

Beef production is a multi-faceted industry. Many different types of cattle are produced under many environmental situations with a multitude of management practices to meet several consumer-demand niches. The set of production conditions (i.e., genetics, nutrition, and other management practices) that will provide maximum efficiency for a commercial cow-calf producer will depend on the particular environmental conditions, marketing demands, and management constraints under which the individual producer operates. The seedstock producer should identify which type(s) of commercial producers for which they wish to provide services, and then develop their breeding objectives and marketing practices accordingly. A good knowledge of cow biology and interacting environmental factors can assist the seedstock producer in that endeavor.

LITERATURE CITED

Ferrell, C.L. and T.G. Jenkins. 1984. Energy utilization by mature, nonpregnant, nonlactating cows of different types. J. Anim. Sci. 58:234.

Freking, B.A. and D.M. Marshall. 1990. Interrelationships of heifer milk production and other biological traits with production efficiency to weaning. S.D. Agr. Exp. Sta. Beef Report CATTLE 90-9:28.

Green, R.D., L.V. Cundiff, G.E. Dickerson and T.G. Jenkins. 1991. Output/input differences among nonpregnant, lactating Bos Indicus-Bos Taurus and Bos Taurus-Bos Taurus F_1 cross cows. J. Anim. Sci. 69:3156-3166.

Jenkins, T.G., L.V. Cundiff and C.L. Ferrell. 1991. Differences among breed crosses of cattle in the conversion of food energy to calf weight during the preweaning interval. J. Anim. Sci. 69:2762-2769.

Kress, D.D., D.E. Doornbos and D.C. Anderson. 1990. Performance of crosses among Hereford, Angus and Simmental cattle with different levels of Simmental breeding. V. Calf Production, milk production and reproduction of three- to eight-year-old dams. J. Anim. Sci. 68:1910.

Marshall, D. M., M.D. Monfore, and C.A. Dinkel. 1990. Performance of Hereford and two-breed rotational crosses of Hereford with Angus and Simmental cattle. I. Calf production through weaning. J. Anim. Sci. 68:4051.

Parnell, P., R. Herd, D. Perry and B. Bootle. 1990. Implications of selection for growth -- The Trangie Cattle Project. Field Day Proceedings. Agric. Res. Center, Trangie New South Wales, Australia.

Solis, J.C., F.M. Byers, G.T. Schelling, C.R. Long and L.W. Greene. 1988. Maintenance requirements and energetic efficiency of cows of different breed types. J. Anim. Sci. 66:764.

Taylor, St. C.S., R.B. Thiessen and J. Murray. 1986. Inter-breed relationship of maintenance efficiency to milk yield in beef cattle. Anim. Prod. 43:37.